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# Survey of Current Seed-Cotton and Lint Cleaning Practices in US Roller Ginning Plants

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***Abstract*.** The US roller ginning industry has changed over the past 15 years. A survey of the US roller gins was conducted to document current roller ginning practices and identify the types and sequences of current seed-cotton and lint cleaning equipment. The survey revealed that there are many differences and some similarities between today's and the 1989 roller ginning industry. There were very few similarities in machinery set-up for seed cotton cleaning among gins. Most gins use one or two cylinder cleaners and an air-jet type cleaner for lint cleaning. The trend in roller ginning today seems to be toward aggressive seed-cotton cleaning and gentle lint cleaning to limit fiber damage.

**Keywords.** Roller ginning, Extra long staple, Pima, Lint cleaning, Seed cotton cleaning, Survey

## Introduction

Pima cotton, an extra-long-staple cotton, is an important crop to the irrigated Southwest. It is valued for its longer and stronger fibers. Pima is roller ginned, a slower, less aggressive process than saw ginning, to minimize damage to the fiber. During the 1989-90 ginning season, 49 roller gins operated in the US: 28 in Arizona, 8 in Texas, 6 in California, 6 in New Mexico, and 1 in Mississippi (Supima, 1989). US Pima cotton production has generally increased slightly over the years, but the number of roller gins has decreased (fig. 1). The majority of Pima production has shifted from Arizona in the late nineteen-eighties to California at present (fig. 2). There were 27 gins during the 2003-04 season: 16 in California, 5 in Arizona, 3 in New Mexico, and 3 in Texas (Supima, 2003). Of the 49 gins operating in 1990, only 12 remain in operation today. The other 15 gins that operated during 2003-04 were new since 1990.

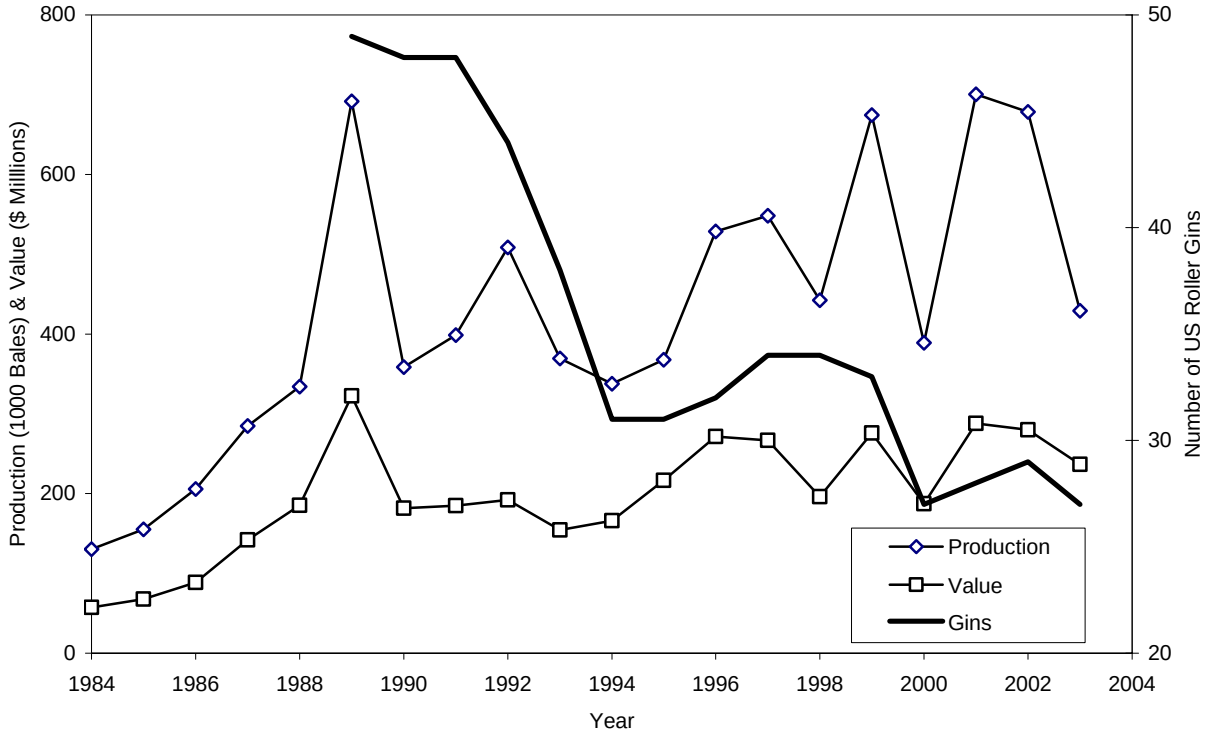


Figure 1. Historical US Pima cotton production, value, and number of gins (USDA, 2005a, Supima, [year]).

Machine harvesting of Pima cotton prompted the use of more cleaning machinery at cotton gins to remove the increased amount of foreign material in the cotton. Over the years, research on seed-cotton and lint cleaning for roller gins has been done by the USDA Ginning Laboratories.

Alberson and Stedronsky (1964) determined that cleaning machine-picked cotton with an elaborate set-up (18 cleaning cylinders, bur extractor, and extractor feeder) increased grade without affecting fiber quality. They also found that pneumatic conveying and lint cleaning removed trash and increased average grade, and caused no detectable damage.

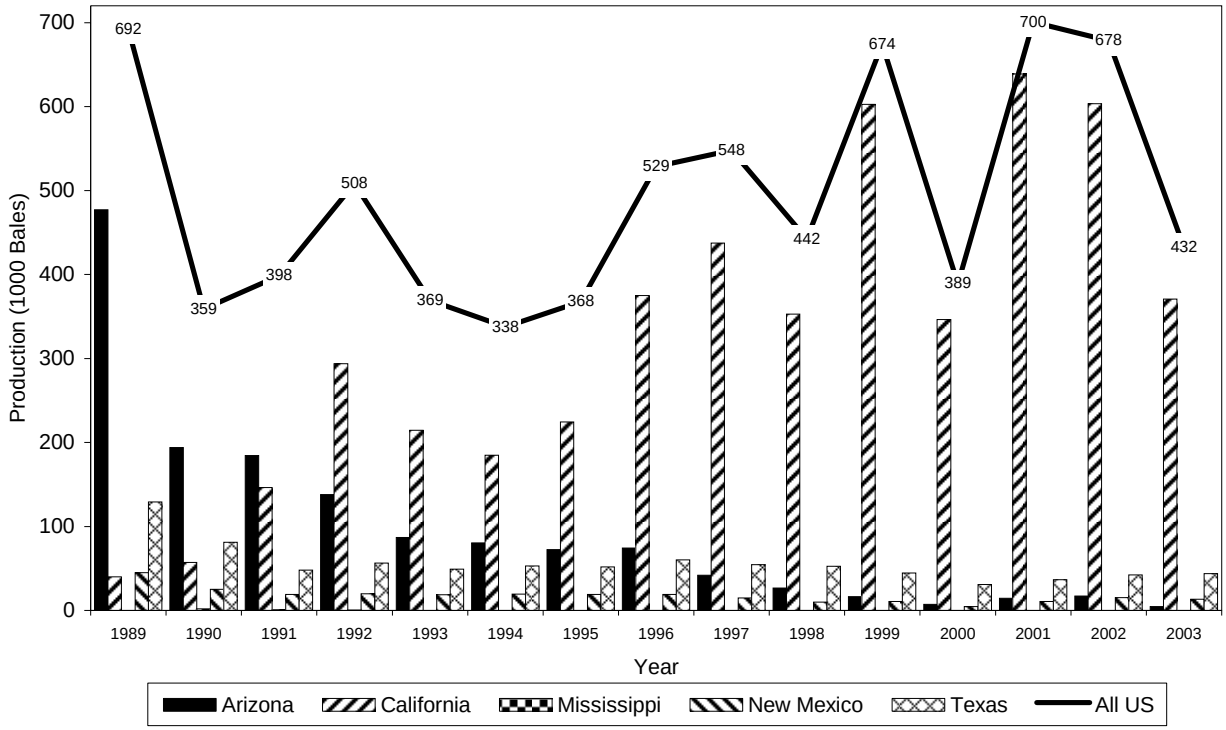


Figure 2. Historical Pima cotton production by state (USDA, 2005b).

Chapman and Mullikin (1968) found that bale value was highest for roller ginned Pima cotton with minimal seed-cotton cleaning and one mill-type lint cleaner. However, these bale values were not significantly higher than bale values from other ginning treatments including elaborate seed-cotton cleaning with no lint cleaning. They also found that the lowest calculated cost per pound of comber sliver resulted from minimal seed-cotton cleaning with no lint cleaning, while the highest cost resulted from the minimal seed-cotton cleaning with one mill-type lint cleaner treatment.

Hughs and Gillum (1991) conducted a survey of US roller gins to determine the type and effectiveness of seed-cotton and lint-cleaning equipment. The study included recording gin-machinery information, and taking seed-cotton and lint samples. The gin machinery information included the number and type of seed-cotton and lint cleaning equipment, the number and set-point of seed-cotton dryers, and number and type of gin stands. They found that the number of seed-cotton cleaners used ranged from three to eight and the cleaning efficiency ranged from 84.2 to 96.1%. Also, 83% of gins used either 1 or 2 cleaners and 1 air-jet for lint cleaning, and lint cleaning efficiency ranged from 12.6 to 62.2%. They were not able to make any specific recommendations on foreign matter removal practice. They did find that gins realized an "average overall gain in bale value" from "some lint cleaning" and fiber tests supported the "reasoning that color grade is the limiting factor in determination of composite grade." They concluded that "more research will be necessary to develop better methods and guidelines for lint cleaning in modern roller-gin plants."

Gillum and Armijo (1997) performed tests to determine the optimum seed-cotton cleaning machinery sequence for Pima cotton. Cleaning efficiency ranged from 54 to 83% for one to nine machines. The highest bale value was achieved with nine machines, but that number was unrealistic for a commercial gin. Thus, no specific recommendations on seed-cotton cleaning for the US roller ginning industry could be made.

The US roller ginning industry has changed considerably over the years; shifting the majority of production to a different area and increasing gin capacity. To better understand how current foreign matter removal practices affect Pima cotton quality, a survey was initiated in 2004 with the following objectives:

1. Document current roller ginning practices.
2. Identify the types and sequences of current seed-cotton and lint cleaning equipment.
3. Assess the effectiveness of the seed-cotton and lint cleaning regimes used by the gins.
4. Develop recommendations for Pima cotton lint cleaning.

This paper summarizes the information collected with the 2004 survey about the operational characteristics, and seed-cotton and lint cleaning machinery at US roller gins.

## Materials and Methods

A survey that involved either gin visits or telephone calls was conducted in 2004. Of the 26 operating gins identified by Supima (2003), two did not participate and two closed permanently. Two gins, one that did not operate during the 2003-04 season, but would the next season, and one new gin, were added to the list. After the survey was completed, it was determined that another gin, not identified earlier, had operated during the 2003-04 season. It was not contacted regarding the survey. Thus, 24 gins are included in the database.

The survey included questions to determine the types and sequences of unloading machinery, drying equipment, seed cotton cleaning machinery, feeders and gin stands, and lint cleaning machinery. Questions were also asked to ascertain the average ginning rate, total bales normally ginned, percentage of cotton in modules, and other characteristics of the operations.

## Results and Discussion

Besides the fact that the roller ginning industry has shifted geographically, some changes in the operation and machinery have also occurred (table 1). The ginning rate has almost doubled (9.8 to 17.3 bph) since 1989; this was mainly due to the increased number of gin stands (8.8 to 15.8). This agrees with the fact, mentioned above, that there has been a slight increase in production, but a sharp decrease in the number of gins. The number of seed cotton cleaners and lint cleaners has changed very little. However, there has been a shift in the types of lint cleaning machinery used. In 1989, most gins (52%) employed two cleaners (either cylinder or impact) and an air-jet for lint cleaning. Today fewer roller gins use that set-up (38%) and more lint cleaning set-ups (33% in 2004 vs. 9% in 1989) now fall into the category that Hughs and Gillum (1991) called "other". "Other" meaning a set-up other than: (1) 2 cleaners and 1 air-jet, (2) 1 cleaner and 1 air-jet, or (3) 2 mill-type cleaners and 2 air-jets.

Table 1. Past and Current US Roller Gin Machinery Trends.

| | 1989 | | 2003 | |
|---|---|---|---|---|
| | Range | Mean | Range | Mean |
| Ginning Rate (bales/hr) | 3 - 26 | 9.8 | 8 - 31 | 17.3 |
| Seed Cotton Cleaners | 3 - 8 | 4.6 | 3 - 11 | 5.0 |
| Gin Stands | 3 - 16 | 8.8 | 6 - 30 | 15.8 |
| Lint Cleaners | 1 - 5 | 2.8 | 2 - 5 | 3.0 |

Table 2 summarizes the information from the survey. The survey revealed that all gins used at least two stages of drying and two-thirds used three stages. For seed cotton cleaning, all gins used at least one cylinder cleaner and the average number of cylinders that Pima cotton was processed by before ginning was 21. All gins surveyed, except one, used at least one stick machine with some using as many as three. Seven gins used impact cleaners. One of those employed five impact cleaners for seed cotton cleaning. There were very few similarities in machinery set-up for seed cotton cleaning among gins.

For lint cleaning, 88% of gins used a cylinder cleaner. Typically one or two cylinder cleaners were used with an average of nine (maximum of 14) cylinders processing lint. Four of the 24 gins surveyed used an impact cleaner. All gins, except one, used at least one air-jet type cleaner. At some of those gins, one of the air-jet type cleaners used was part of a mill-type cleaning unit. Six gins employed a newer design mill-type cleaning unit that incorporates an air-jet cleaner. One gin used two older model mill-type cleaners that were popular well before the industry began to shift to California and have gone out of use since then. The most common machinery set-up for lint cleaning was one or two cylinder cleaners and one air-jet type cleaner. This was different from 1989 when the most common lint cleaning set-up was one cylinder cleaner, one impact cleaner, and one air-jet type cleaner (Hughs and Gillum, 1991).

Table 2. Summary of Roller Gin Machinery Survey Results.

| | Units | Mean | Range | Gins (%) |
|---|---|---|---|---|
| Ginning Rate | Bale/hr | 17.4 | 8 - 32 | |
| Drying | | | | |
| 1 Stage | °F | 207.6 | 155 - 280 | 100 |
| 2 Stage | °F | 204.1 | 155 - 260 | 100 |
| 3 Stage | °F | 190.6 | 150 - 245 | 67 |
| Seed Cotton Cleaners | # | 5.0 | 3 - 11 | |
| Cylinder Cleaners | # | 3.0 | 1 - 5 | 100 |
| Total Cylinders | # | 21.0 | 6 - 49 | |
| Stick Machines | # | 1.3 | 0 - 3 | 96 |
| Impact Cleaners | # | 0.5 | 0 - 5 | 29 |
| Gin Stands | # | 15.8 | 6 - 30 | |
| Lint Cleaners | # | 2.6 | 1 - 4 | |
| Cylinder Cleaners | # | 1.3 | 0 - 2 | 88 |
| Total Cylinders | # | 8.8 | 0 - 14 | |
| Impact Cleaners | # | 0.2 | 0 - 1 | 17 |
| Air jet | # | 1.1 | 0 - 2 | 96 |
| Mill-type | # | 0.3 | 0 - 2 | 29 |

## Conclusions

The US roller ginning industry has changed since 1989. The majority of gins have shifted from Arizona to California. The number of gins in the US has fallen by nearly 50%, but those operating today are larger and process about the same number of bales at nearly twice the rate.

There were very few similarities in machinery set-up for seed cotton cleaning among gins. Most gins use one or two cylinder cleaners and an air-jet type cleaner for lint cleaning. The trend in roller ginning today seems to be toward aggressive seed cotton cleaning and gentle lint cleaning to limit fiber damage.

To assess the effectiveness of the different seed-cotton and lint cleaning regimes used by the gins during the 2004-05 ginning season, seed-cotton and lint samples will be collected for

foreign matter and fiber quality analysis. The gins selected for sampling will be representative of the different lint cleaning and seed-cotton cleaning set-ups. Whenever practical, three modules will be sampled at each gin; either from different growers, and/or different varieties, and/or from different fields. Seed-cotton foreign-matter content will be determined and lint samples will be classed and Advance Fiber Information System and Shirley Analyzer analyses will be performed on the raw fiber.

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### *Disclaimer*

Use of a trade name, propriety product or specific equipment does not constitute a guarantee or warranty by the United States Department of Agriculture and does not imply approval of a product to the exclusion of others that may be suitable.

## References

Alberson, D.M. and V.L. Stedronsky. 1964. Roller ginning American-Egyptian cotton in the Southwest. USDA Agricultural Handbook No. 257. Washington, DC: GPO.

Chapman, W.E. and R.A. Mullikin. 1968. Effects of gin cleaning on fiber properties and spinning quality, pima cotton, 1965-66, with and without crusher rolls. USDA Marketing Research Report No. 806. Washington, DC: GPO.

Hughs, S.E. and M.N. Gillum. 1991. Quality effects on current roller-gin lint cleaning. *Trans ASAE* 7(6):673-676.

Gillum, M.N. and C.B. Armijo. 1997. Pima seed cotton cleaning for maximum profit. *Trans ASAE* 40(3):513-518.

USDA. 2005a. Crop Values. USDA Economics and Statistics System. Washington, DC: USDA National Agricultural Statistics Service. Available at: usda.mannlib.cornell.edu/reports/nassr/price/zcv-bb/. Accessed July 2004.

USDA. 2005b. Cotton Ginnings - Annual Reports. USDA Economics and Statistics System. Washington, DC: USDA National Agricultural Statistics Service. Available at: usda.mannlib.cornell.edu/reports/nassr/field/pcg-bban/. Accessed July 2004.

Supima. [year]. *Supima News.* Phoenix, AZ: Supima Association of America.